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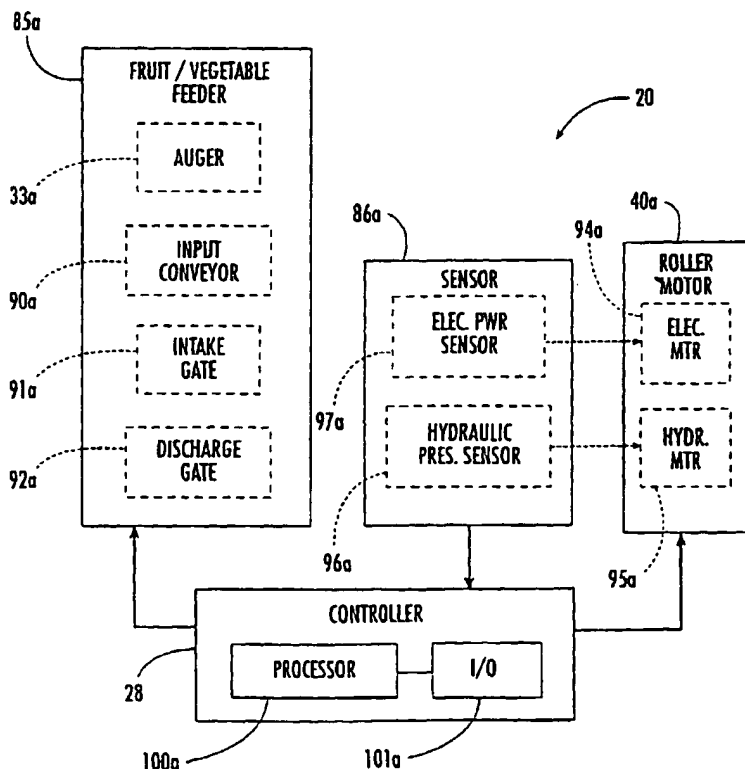
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[Continued on next page]

(54) Title: **PEELING APPARATUS HAVING FEEDER CONTROL BASED UPON LOAD AND ASSOCIATED METHODS**



(57) Abstract: A peeling apparatus includes a set of abrasive rollers (20), at least one roller drive motor (40a), a feeder (85a) for controllably feeding fruit or vegetables adjacent the abrasive rollers, at least one sensor (86a) associated with at least one roller drive motor for sensing a load thereon, and a controller (28) for controlling the feeder based upon a sensed load. The controller may increase the feed rate based upon an increase in sensed load, and decrease the feed rate of the auger based upon a decrease in sensed load. The at least one roller drive motor may be a hydraulic or electric motor.

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**PEELING APPARATUS HAVING FEEDER
CONTROL BASED UPON LOAD
AND ASSOCIATED METHODS**

Field of the Invention

This invention relates to the field of food processing, and more particularly, to apparatus and methods for peeling vegetables and fruits.

5

Background of the Invention

It is common in many food processing applications to require the peeling of the outer skin of fruits or vegetables. Potatoes, in particular, are very often so processed by passing the potatoes against a set of rotating abrasive rollers. Fruit may also be similarly processed. For example, U.S. Patent No. 2,605,798 to Boswell discloses a citrus fruit peeler including a pair of abrading rollers and an auger screw which advances the citrus along the rollers.

15

Along these lines, U.S. Patent No. 3,745,914 to Wallace discloses a single chamber fruit and vegetable peeler including a frame, a plurality of abrasive roller carried by the frame and arranged in an arcuate pattern, and a drive motor and gears coupled to the rollers. The abrasive rollers are provided in lengthwise segments to facilitate replacement of a damaged section without requiring replacement of an entire roller. Action of the rollers advances the fruit or vegetables from an intake to a discharge. A

20

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rinsing system is provided to wash material from the rollers. The vegetables or fruit are subjected to a tumbling action within the peeling chamber. The amount of peeling is controlled by a height of a gate at the
5 discharge.

U.S. Patent No. 4,519,305 to Vanosdall discloses a similar apparatus wherein an auger extends only partway into the chamber from the discharge. U.S. Patent No. 5,858,429 also to Wallace discloses a
10 similar apparatus which includes an auger at a feed hopper, and a rotatable tumbler including rotating paddles within the peeling chamber. This patent also discloses a vision analysis system to evaluate the degree of peeling and adjust the various parameters to
15 provide a desired degree of peeling.

U.S. Patent Nos. 4,237,782 to Bichel and 4,827,836 to Neidigh disclose peeling apparatus wherein the abrasive rollers are driven by individual hydraulic motors. U.S. Patent No. 5,780,088 to Zittel discloses
20 a peeler that includes individual electric motors to drive each roller. The rollers can be operated at different speeds or in different directions. An auger which extends through the peeling chamber, may also be controlled by an electric motor.

25 To increase capacity, a dual peeling or washing chamber apparatus was offered by Vanmark Corporation under the model designation Series 2800. The apparatus included two side-by-side chambers wherein the augers rotated in a same direction.
30 Accordingly, the abrasive rollers and their associated motors extended around an arc further upward on a same side.

Unfortunately, it may be difficult to manually control the various operating parameters of a
35 typical peeling apparatus to obtain consistent results.

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This may be so particularly where the feed rate is difficult to control and/or the fruit or vegetables vary in size, shape and skin thickness. Vision-based feedback control systems may be relatively expensive
5 and complicated to adjust for correct and consistent operation.

Summary of the Invention

In view of the foregoing background, it is
10 therefore an object of the invention to provide a peeling apparatus and associated methods which provide for efficient and effective control of the peeling operation.

This and other objects, features and
15 advantages in accordance with the present invention are provided by a peeling apparatus comprising a set of abrasive rollers, at least one roller drive motor, a feeder for controllably feeding fruit or vegetables adjacent the abrasive rollers, at least one sensor
20 associated with at least one roller drive motor for sensing a load thereon, and a controller for controlling the feeder based upon the at least one sensor. Accordingly, the feeder can be controlled based upon the sensed load on the abrasive rollers.

25 The controller may increase the feed rate of the feeder based upon an increase in sensed load, and conversely decrease the feed rate based upon a decrease in sensed load. In some embodiments, the controller may also control at least one roller drive motor of the
30 set based upon the sensed load. The invention provides a relatively straightforward, robust and cost effective approach to control important peeling parameters.

The feeder may comprise an input conveyor upstream of the set of abrasive rollers. In addition

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to or in place of the input conveyor, the feeder may include an auger adjacent the set of abrasive rollers. Also, the feeder may include at least one of an intake gate and a discharge gate, with or without the input
5 conveyor and/or auger.

The at least one sensor may comprise a torque sensor for sensing a torque delivered by the at least one roller drive motor. The roller drive motor may be a hydraulic motor, and the sensor may sense hydraulic
10 pressure.

In one particularly advantageous class of embodiments, the at least one roller drive motor may comprise at least one roller drive electric motor. Accordingly, the at least one torque sensor may thus
15 comprise at least one electrical power sensor.

In some embodiments, the at least one roller drive electric motor may comprise a respective roller drive electric motor for each abrasive roller. In these embodiments, the load on only one or more motors
20 for the lower abrasive rollers may need to be sensed.

A method aspect of the invention is for operating a peeling apparatus of a type comprising a set of abrasive rollers, at least one roller drive motor, and a feeder. The method may comprise sensing a
25 load on at least one roller drive motor, and controlling a feed rate of the feeder based upon the sensed load.

Brief Description of the Drawings

FIG. 1 is a perspective view of a peeling
30 apparatus in accordance with the invention.

FIG. 2 is an intake end view of the peeling apparatus of FIG. 1.

FIG. 3 is a discharge end view of the peeling apparatus of FIG. 1.

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FIG. 4 is a cross-sectional view taken along lines 4-4 of FIG. 3.

FIG. 5 is an enlarged cross-sectional view of the intake end of an abrasive roller, its flange bearing, removable mount and drive motor as used in the peeling apparatus of FIG. 1.

FIG. 6 is an enlarged end view of a discharge portion of the peeling apparatus of FIG. 1 illustrating the flange bearings supporting the discharge ends of the abrasive rollers.

FIG. 7 is an enlarged cross-sectional view of the discharge end of a abrasive roller and its associated flange bearing as used in the peeling apparatus of FIG. 1.

FIG. 8 is a perspective view of an abrasive roller as may be used in the peeling apparatus of FIG. 1.

FIG. 9 is a greatly enlarged cross-sectional view taken along lines 9-9 of FIG. 8 illustrating an individual knurl embodiment.

Detailed Description of the Preferred Embodiments

The present invention will now be described more fully hereinafter with reference to the accompanying drawings in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Referring initially to FIGS. 1-4 the peeling apparatus 20 in accordance with the present invention is now described. The peeling apparatus 20 may be part

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of an overall fruit or vegetable processing system 25 that may include other processing apparatus 21, 22 as schematically illustrated. In addition, these other processing apparatus 21, 22 may also be connected to a
5 common plant cleaning solution system 23 including a cleaning solution supply and associated interconnecting piping. Similarly, these other processing apparatus 21, 22 may also be connected to a common plant cleaning solution collection system 24 including a drain, sump
10 or collection vessel and interconnecting piping as will be appreciated by those skilled in the art.

The peeling apparatus 20 may include the lower collection pan 29 and the outlet port 31 in communication therewith which define the cleaning
15 solution collection system for the peeling apparatus, and which may be coupled to the common plant cleaning solution collection system 24. Of course, the cleaning solution from the peeling apparatus 20 may also be recycled and used again for cleaning the peeler and/or
20 any of the other processing apparatus 21, 22. Also the cleaning solution from the common plant cleaning solution delivery system 23 may be distributed or sprayed on interior portions of the peeling apparatus 20 using the schematically illustrated nozzles 35
25 (FIG. 4).

The peeling apparatus 25 illustratively includes two generally horizontally extending, side-by-side peeling chambers 26a, 26b, but many of the features and components thereof may also be used in a
30 single peeling chamber apparatus, and/or in a peeling apparatus arranged at an angle other than horizontal as will be readily appreciated by those skilled in the art. The peeling apparatus 20 is also illustratively fed fruit or vegetables from one or more upstream

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devices, schematically illustrated in FIG. 1 by the fruit/vegetable supply 27. In addition, the peeling apparatus 20 also includes a controller 28 connected to the various motors and other equipment as will be described in greater detail below.

The peeling apparatus 20 may be used for many peeling operations to be performed typically on fruit or vegetables. For example, the peeling apparatus 20 may be used to extract oil from the peels of citrus fruit as disclosed in parent U.S. patent application serial no. 09/576,924 filed on May 23, 2000, the entire disclosure of which is incorporated herein by reference. Of course, the peeling apparatus 20 may be used for peeling potatoes, and other fruit and vegetables as will be appreciated by those skilled in the art.

The peeling apparatus 20 illustratively includes a frame 30 which carries the first and second peeling chambers 26a, 26b in side-by-side relation. The first peeling chamber 26a includes a first set of abrasive rollers 32a and a first auger 33a adjacent thereto. Similarly, the second peeling chamber 26b comprises a second set of abrasive rollers 32b and a second auger 33b adjacent thereto. Each auger 33a, 33b has a respective electric drive motor 34a, 34b connected thereto. Of course, a discharge opening 37a, 37b is provided at the discharge end of each peeling chamber 26a, 26b as shown perhaps best in FIGS. 1 and 4. The discharge openings 37 are illustratively arcuate in shape and offset to the respective outer sides. A common intake opening 39 (FIG. 2) is provided at the intake end to receive the fruit or vegetables therein.

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In accordance with one aspect of the peeling apparatus 20, the first and second augers 33a, 33b include respective helical flights oriented in opposite helical directions. The drive motors 34a, 34b drive
5 the first and second augers 33a, 33b in opposite rotational directions. In other words, the drive motors 341, 34b define a drive for the augers 33a, 33b. The fruit or vegetables in each peeling chamber 26a, 26b is advanced in parallel from the intake to the
10 discharge end of the peeling apparatus 20.

The first set of abrasive rollers 32a are aligned along a first arc, and the second set of abrasive rollers 32b are aligned along a second arc being a mirror image of the first arc. Moreover, the
15 first and second arcs each extend higher along outsides of the peeling apparatus 20. This may be accommodated since rotation of the augers 33a, 33b tends to cause the fruit to ride up toward the outside as will be appreciated by those skilled in the art. This
20 arrangement of rollers provides a number of advantages, particularly in that more rollers are accessible from the exterior of the peeling apparatus 20, rather than being positioned on the less accessible interior as will be appreciated by those skilled in the art.

25 Another aspect of the peeling apparatus 20 is that the number of abrasive rollers 32a, 32b in each of the first and second sets may be greater than eight. In the illustrated embodiment, twelve rollers are provided in each set. A combined or total number of
30 abrasive rollers 32a, 32b in both of the first and second sets is also preferably greater than sixteen. In the illustrated peeling apparatus 20 the total number of rollers is twenty-four. The larger number of rollers may provide a greater throughput in a smaller

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machine footprint. Accordingly, the peeling apparatus 20 may be installed or retrofitted into a relatively small space.

Referring now more particularly to FIG. 2 and additionally to FIG. 5, other advantageous features of the peeling apparatus 20 are now described. In particular, each peeling chamber 26a, 26b illustratively includes a set of motors 40a, 40b and associated mounts 41a, 41b for the abrasive rollers. These motors 40a, 40b and mounts 41a, 41b are illustratively carried by the intake end, accordingly, the fruit or vegetables can more readily pass out of the discharge openings unencumbered by the motors and mounts as will be appreciated by those skilled in the art.

For clarity of explanation, only a single motor 40a, mount 41a, and intake end of a roller 32a will now be described, although those of skill in the art will appreciate that this configuration may be duplicated for all of the rollers in both peeling chambers 26a, 26b. More particularly, the frame 30 includes a roller opening 45a adjacent the intake end. The roller opening 45a may be an arcuately shaped slotted opening for the set of rollers as in the illustrated embodiment, or individual openings could be provided for each roller as will be appreciated by those skilled in the art. The mount 41a is also connected to the intake end adjacent the roller opening 45a, and this mount carries the intake end of the abrasive roller 32a as well as the motor 40a.

The mount 41a permits the abrasive roller 32a to be installable or removable through the roller opening 45a upon removal of the mount 41a from the frame 30. The mount 41a also permits the roller drive

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motor **40a** to be separately removed, such as for service or replacement.

The abrasive roller **32a** illustratively comprises an elongate body portion **60a** having an
5 abrasive outer surface as will be described in greater detail below, and an intake mounting stub **61a** and a discharge mounting stub **62a** (FIG. 7) permanently affixed to respective opposing ends of elongate body portion. Each mounting stub may include a body portion
10 received within an open end of the elongate body portion **60a**, and may also include an integrally formed shaft extending outwardly therefrom. Other similar constructions are also possible.

The mounting stubs **61a**, **62a** are preferably
15 permanently affixed to the ends of the elongate body portion **60a** to provide for higher rotational speeds with less vibration and resonance as will be appreciated by those skilled in the art. For example, in those embodiments where the elongate body portion
20 **60a** of the abrasive roller **32a** comprises metal, such as steel or aluminum, the mounting stubs **61a**, **62a** may be permanently affixed by welding, although similar techniques are also contemplated by the present invention.

25 In the illustrated embodiment, the mount **41a** illustratively includes a base plate **46a** covering overlying the opening **45a** and secured to the frame **30**. A flange bearing **47a** is carried by the base plate **46a** and rotatably supports the intake mounting stub **61a** at
30 the end of the abrasive roller **32a**. The mount **41a** also illustratively includes the motor standoff **50a** also carried by the base plate **46a** and which is coaxial with the end of the mounting stub **61a** and output shaft **53a**

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of the motor **40a**. The output shaft **53a** of the motor **40a** is connected to the end of the mounting stub **61a** via a flexible coupling **51a** which may also permit higher rotational speeds for the abrasive roller **32a** by
5 reducing vibration.

The schematically illustrated motor **40a** may include an electric or hydraulic actuator directly coupled to the output shaft **53a**, or an intervening gearbox may be provided to produce a desired rotational
10 speed of the abrasive roller **32a** as will be appreciated by those skilled in the art. The motor **40a** is illustratively connected to a motor mounting plate **52a** which, in turn, is carried by the end of the motor standoff **50a**. Other equivalent mounting arrangements
15 are also contemplated by the invention. In some alternate embodiments, the individual motors may be replaced by a common motor and associated drive train for driving the sets of rollers.

As perhaps best seen with reference to FIG.
20 2, the mounts **41a**, **41b**, and, more particularly, the base plates thereof, may have a trapezoidal shape. Accordingly, when the mounts **41a**, **41b** are arranged in side-by-side relation, the mounts define an arc.

Turning now additionally to FIGS. 6 and 7,
25 another advantageous aspect of the peeling apparatus 20 is described. More particularly, respective sets of flange bearings **70a**, **70b** are provided at the discharge end of the peeling apparatus for each of the peeling chambers **26a**, **26b**. Each flange bearing **70a** is
30 illustratively provided by a flange bearing having a generally oval footprint with first and second fastener openings adjacent opposing ends of the footprint and which, in turn, receive respective first and second fasteners **72a** to secure the flange bearing in place.

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The flange bearing **70a** of the mount **41a** rotatably supports the discharge mounting stub **62a** of the abrasive roller **32a**.

Moreover, as best seen in FIG. 7, each flange bearing **70a** with its generally oval footprint may be readily canted at an angle and nested into an adjacent flange bearing. In contrast, pillow block bearings, for example, may be difficult to accurately position and may take up additional space. Accordingly, the flange bearings **70a**, **70b** of the peeling apparatus **20** provide a very compact arrangement adjacent the discharge openings **37a**, **37b** so that the fruit or vegetables may be easily discharged therefrom.

Referring now additionally to FIGS. 8 and 9 other aspects relating to the abrasive roller **32a** of the peeling apparatus **20** are further described. The abrasive roller **32a** includes an elongate body portion **60a**, preferably in the form of an elongate tube to thereby reduce overall weight. The tubular shape may be readily and accurately formed by precision centerless grinding techniques as will be appreciated by those skilled in the art.

Mounting stubs **61a**, **62a** are preferably welded to opposing ends of the tubular elongate body portion **60a** as described above, and an abrasive surface is formed on the outer surface portion of the elongate body portion. The abrasive outer surface may be manufactured by pressing the outer roller surface against a shaping or die surface to form a pattern of knurls, similar to a #10TPI knurl. In other words, the knurls may be integrally formed into the surface of the elongate body portion **60a**.

A cross-section of one such knurl **75a** is shown in FIG. 9. The illustrated knurl **75a** may define

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a peak height of about 0.050 inches with a tolerance of about +0.00 and -0.020 inches. The abrasive roller **32a** may have a diameter of about 3.9 to 4.0 inches, although other sizes are also possible. Moreover, the
5 knurl **75a** may have a leading edge portion **76a** that is steeper than the adjacent trailing edge portion **77a**. For example, the leading edge portion **76a** may define an angle α of about a thirty degrees from a line normal to the surface. Also, the trailing edge portion **77a** may
10 define an angle β of about sixty degrees from a line normal to the surface. Other angles are also possible. The steeper angle of the leading edge portion **76a** may provide an extended wear life, and reduce the need for maintenance. In some embodiments, all of the knurls
15 may have a same shape, although other embodiments may benefit from different shaped knurls.

To further provide increased wear resistance for the knurl **75a** a wear-resistant surface coating **80a** may be applied to cover the base metal of the elongate
20 body portion **60a**. For example, the elongate body portion **60a** may comprise steel or aluminum, and the surface coating **80a** may comprise cobalt, chromium, tungsten, nickel, or alloys thereof. For example, Stellite® may be used as the coating **80a** and it is an
25 alloy family containing cobalt, chromium, tungsten and other elements as will be readily appreciated by those skilled in the art.

In other embodiments, the base metal of the abrasive roller **32a** may not require a coating. For
30 example, stainless steel may not require a protective coating. To reduce overall costs, in one preferred embodiment, a mild steel base metal may be combined

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with the protective coating **80a** as will be appreciated by those skilled in the art.

Turning now additionally to the schematic diagrams of FIGS. 10-11, various control aspects of the peeling apparatus **20** are now described. In particular, the peeling apparatus **20** includes a set of abrasive rollers **32a** arranged to define a peeling chamber **26a**, and roller drive motors **40a** as explained in detail above. A feeder **85a** is provided for controllably feeding fruit or vegetables adjacent the abrasive rollers. A sensor **86a** is associated with at least one roller drive motor **40a** for sensing a load thereon. For example, the sensor **86a** may be associated with one or more lower rollers to more accurately sense the load, although sensors may be provided for all of the motors as will be appreciated by those skilled in the art. The controller **28** is illustratively connected to the sensor **86a** and feeder **85ab** for controlling the feeder based upon the sensor. Accordingly, the feeder **85a** can be controlled based upon the sensed load on the abrasive roller **32a**.

For example, for typical operation, the controller **28** may increase the feed rate of the feeder **85a** based upon an increase in sensed load, and conversely decrease the feed rate based upon a decrease in sensed load. In some embodiments, the controller **28** may also control one more of the roller drive motors **40a** based upon the sensed load. This aspect of the peeling apparatus **20** provides a relatively straightforward, robust and cost effective approach to control important peeling parameters.

As understood with particular reference to FIG. 11, the feeder **85b** may comprise an input conveyor

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90a upstream of the set of abrasive rollers. In addition to or in place of the input conveyor 90a, the feeder may include the auger 33a adjacent the set of abrasive rollers. Also, the feeder 85a may include at least one of an intake gate 91a and a discharge gate 92a, and with or without the input conveyor and/or auger. Those of skill in the art will recognize other feeder configurations that are controllable in accordance with this aspect of the peeling apparatus

10 20.

The sensor 86a may comprise a torque sensor for sensing a torque delivered by the roller drive motor 40a. In one class of embodiments, the roller drive motor 40a may be a hydraulic motor 95a, and the sensor 86a may be a hydraulic pressure sensor 96a. In one particularly advantageous class of embodiments, the roller drive motor 40a may comprise a roller drive electric motor 94a. Accordingly, for this class of embodiments, the torque sensor may thus comprise an electrical power sensor 97a.

15 20

The controller 28 itself may include a processor 100a and various input/output devices 101a connected thereto. For example, the input/output devices 101a may include an operator CRT display or other indicators, as well as a keyboard or other input devices as will be appreciated by those skilled in the art. Of course, the controller 28 may provide a range of from full automatic to full manual control as will also be appreciated by those skilled in the art.

25 30

In addition, other features relating to the apparatus and method for peeling vegetables and fruit are disclosed in copending patent applications filed concurrently herewith and assigned to the assignee of the present invention and are entitled PEELING

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APPARATUS AND ASSOCIATED METHODS, attorney work docket
number 12426/56041; and PEELING APPARATUS WITH ENHANCED
ABRASIVE ROLLERS AND ASSOCIATED METHODS, attorney work
docket number 12427/56042, the entire disclosures of
5 which are incorporated herein in their entirety by
reference.

Many modifications and other embodiments of
the invention will come to the mind of one skilled in
the art having the benefit of the teachings presented
10 in the foregoing descriptions and the associated
drawings. Accordingly, it is understood that the
invention is not to be limited to the embodiments
disclosed, and that other modifications and embodiments
are intended to be included within the spirit and scope
15 of the appended claims.

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THAT WHICH IS CLAIMED IS:

1. A peeling apparatus comprising:
a frame;
a set of abrasive rollers carried by said
5 frame;
at least one roller drive motor connected to
said set of abrasive rollers;
a feeder for controllably feeding fruit or
vegetables adjacent said set of abrasive rollers;
10 at least one sensor associated with said at
least one roller drive motor for sensing a load
thereon; and
a controller for controlling said feeder
based upon said at least one sensor.
15
2. A peeling apparatus according to Claim 1
wherein said feeder comprises an input conveyor
upstream of said set of abrasive rollers.
3. A peeling apparatus according to Claim 1
wherein said feeder comprises an auger adjacent said
20 set of abrasive rollers.
4. A peeling apparatus according to Claim 1
wherein said feeder comprises at least one of an intake
gate and a discharge gate.
5. A peeling apparatus according to Claim 1
25 wherein said controller increases a feed rate of said
feeder based upon an increase in sensed load, and
decreases the feed rate of said feeder based upon a
decrease in sensed load.
6. A peeling apparatus according to Claim 1
30 wherein said controller also controls said at least one
roller drive motor based upon the sensed load.
7. A peeling apparatus according to Claim 1
wherein said at least one sensor comprises a torque
sensor for sensing a torque delivered by said at least
35 one roller drive motor.

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8. A peeling apparatus according to Claim 7 wherein said at least one roller drive motor comprises at least one roller drive hydraulic motor; and wherein said at least one torque sensor comprises at least one
5 hydraulic pressure sensor.

9. A peeling apparatus according to Claim 7 wherein said at least one roller drive motor comprises at least one roller drive electric motor; and wherein said at least one torque sensor comprises at least one
10 electrical power sensor.

10. A peeling apparatus according to Claim 9 wherein said at least one roller drive electric motor comprises a respective roller drive electric motor for each abrasive roller.

11. A peeling apparatus according to Claim 10 wherein said set of abrasive rollers are arranged along an arc and extend in a generally horizontal direction; and wherein said at least one electrical power sensor is connected to at least one roller drive
20 electric motor for a respective at least one lower abrasive roller.

12. A peeling apparatus comprising:
a frame;
a set of abrasive rollers carried by said
25 frame;

a set of roller drive motors, each connected to a respective one of said set of abrasive rollers;

a feeder for controllably feeding fruit or vegetables adjacent said set of abrasive rollers;

30 at least one torque sensor associated with at least one of said roller drive motors; and

a controller for controlling said feeder based upon said at least one torque sensor.

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13. A peeling apparatus according to Claim 12 wherein said feeder comprises an input conveyor upstream of said set of abrasive rollers.

14. A peeling apparatus according to Claim 5 12 wherein said feeder comprises an auger adjacent said set of abrasive rollers.

15. A peeling apparatus according to Claim 12 wherein said feeder comprises at least one of an intake gate and a discharge gate.

10 16. A peeling apparatus according to Claim 12 wherein said controller increases a feed rate of said feeder based upon an increase in sensed load, and decreases the feed rate of said feeder based upon a decrease in sensed load.

15 17. A peeling apparatus according to Claim 12 wherein said controller also controls at least one roller drive motor of said set thereof based upon the sensed load.

18. A peeling apparatus according to Claim 20 12 wherein said at least one roller drive motor comprises at least one roller drive hydraulic motor; and wherein said at least one torque sensor comprises at least one hydraulic pressure sensor.

19. A peeling apparatus according to Claim 25 12 wherein said at least one roller drive motor comprises at least one roller drive electric motor; and wherein said at least one torque sensor comprises at least one electrical power sensor.

20. A method for operating a peeling 30 apparatus of a type comprising a set of abrasive rollers and at least one roller drive motor associated therewith, and a feeder for controllably feeding fruit or vegetables adjacent the set of abrasive rollers, the method comprising:

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sensing a load on at least one roller drive motor; and

controlling a feed rate of the feeder based upon the sensed load.

5 21. A method according to Claim 20 wherein controlling comprises increasing the feed rate of the feeder based upon an increase in sensed load, and decreasing the feed rate of the feeder based upon a decrease in sensed load.

10 22. A method according to Claim 20 further comprising controlling the at least one roller drive motor based upon the sensed load.

 23. A method according to Claim 20 wherein sensing the load comprises sensing a torque delivered
15 by the at least one roller drive motor.

 24. A method according to Claim 23 wherein the at least one roller drive motor comprises at least one roller drive hydraulic motor, and wherein sensing the torque comprises sensing hydraulic pressure to the
20 at least one roller drive hydraulic motor.

 25. A method according to Claim 23 wherein the at least one roller drive motor comprises at least one roller drive electric motor; and wherein sensing torque comprises sensing electrical power to the at
25 least one roller drive electric motor.

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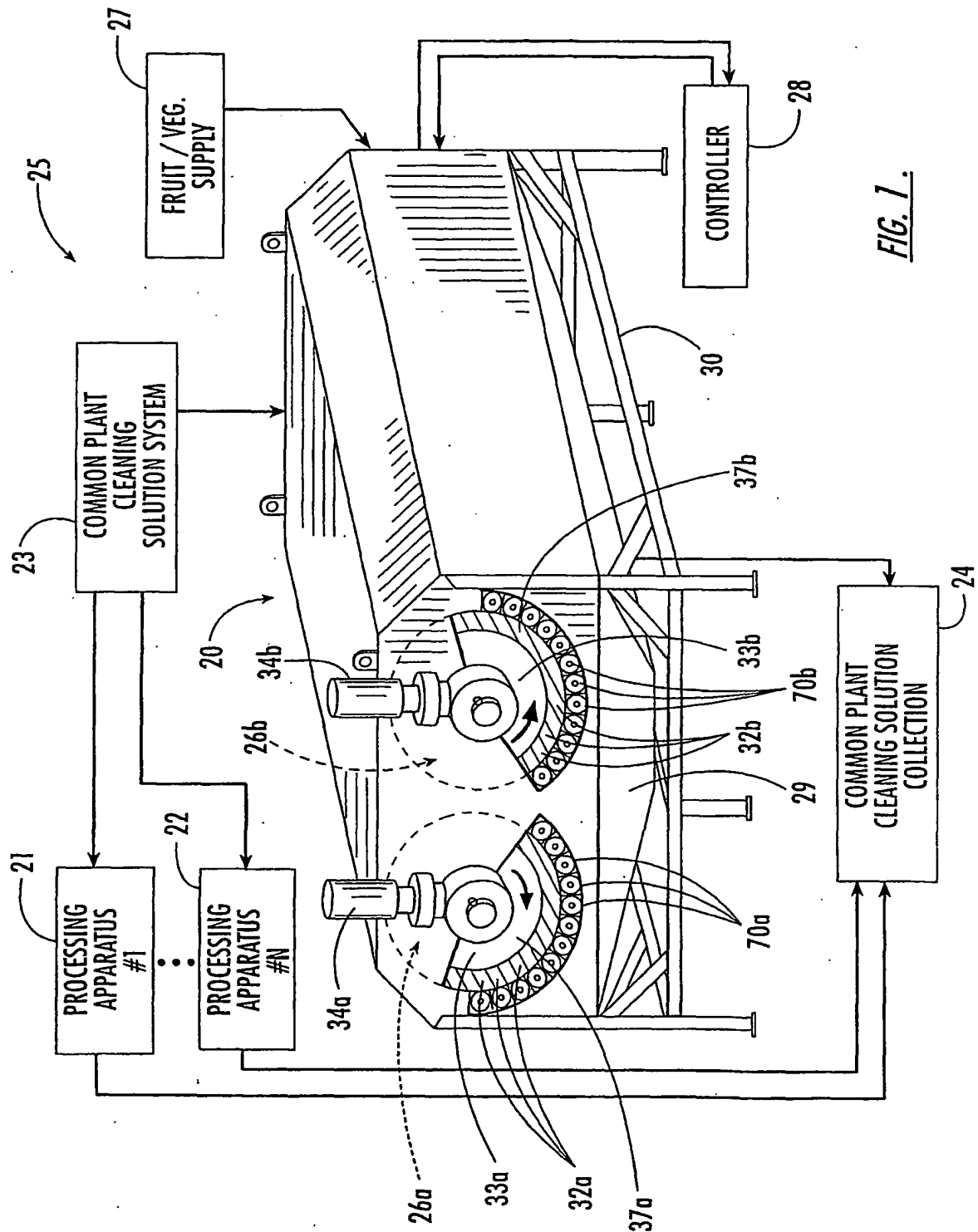


FIG. 1.

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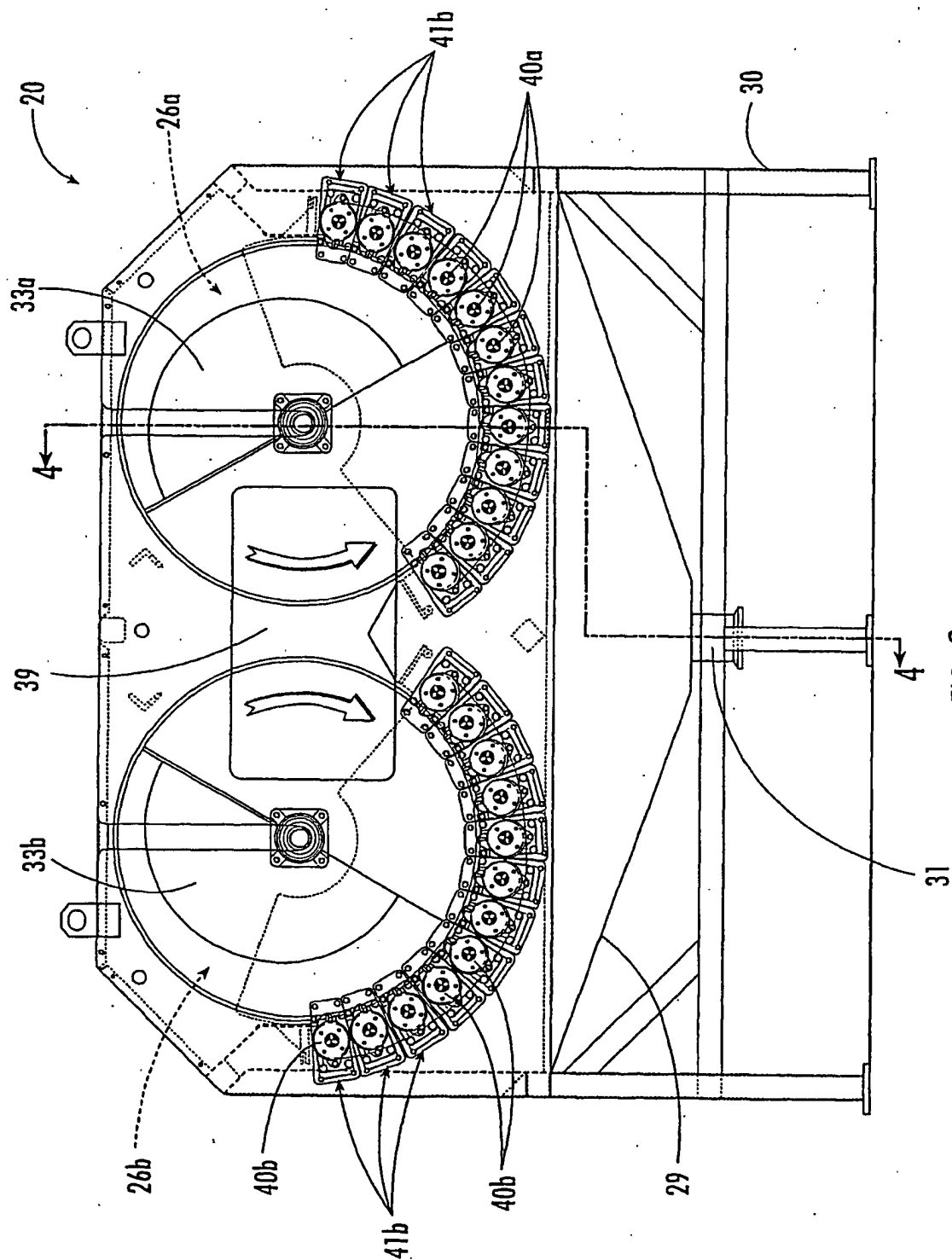


FIG. 2

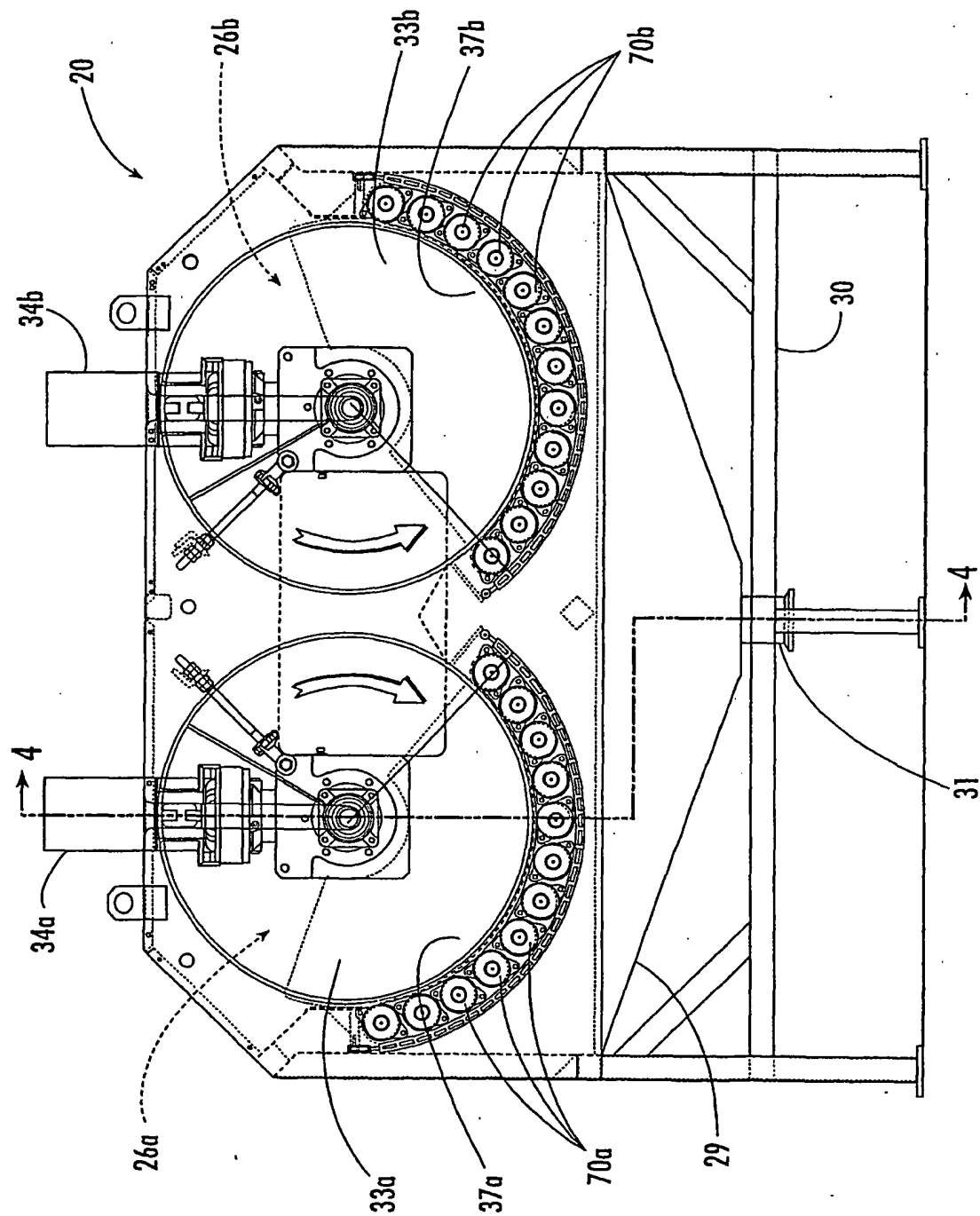


FIG. 3.

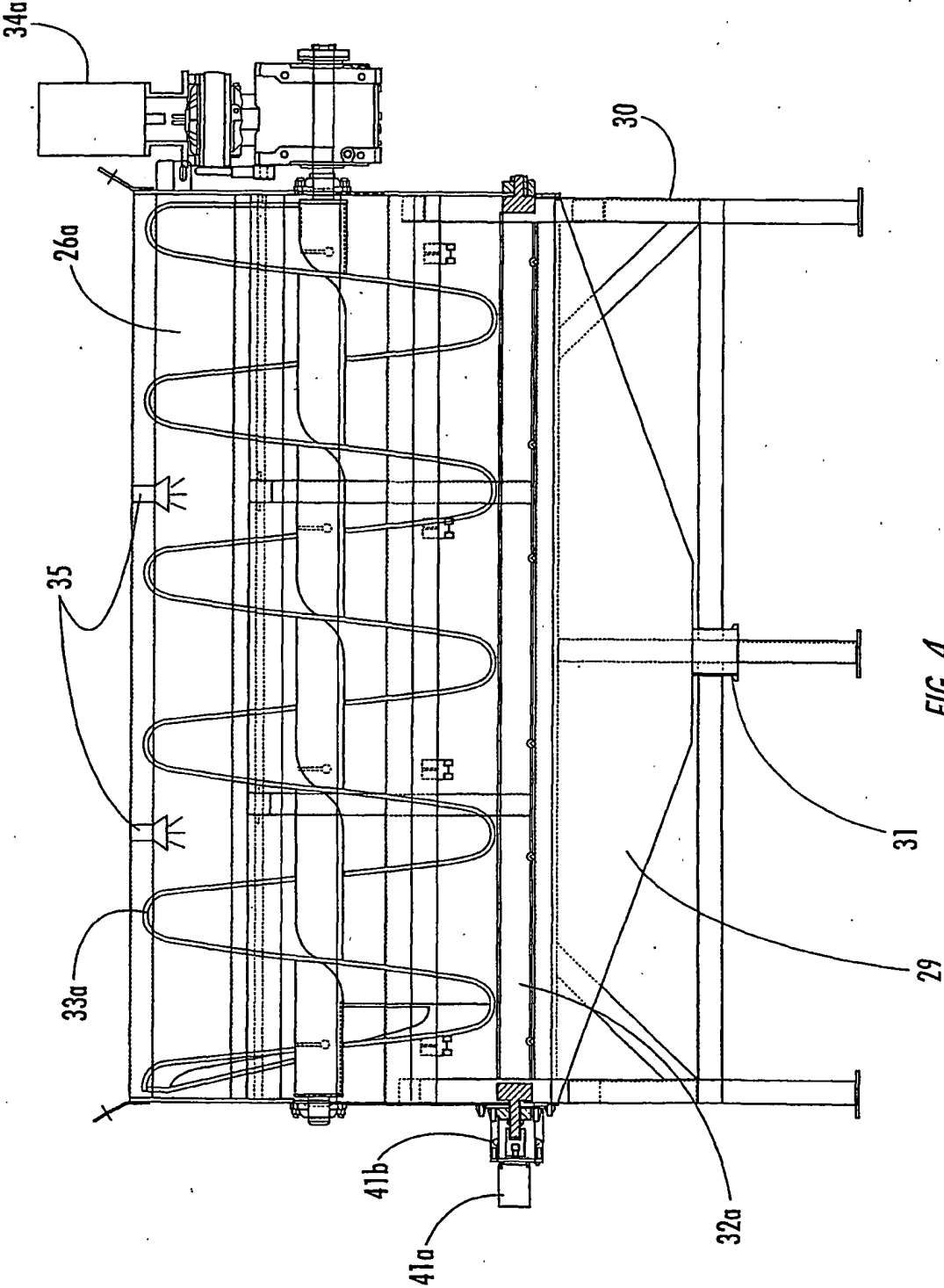


FIG. 4.

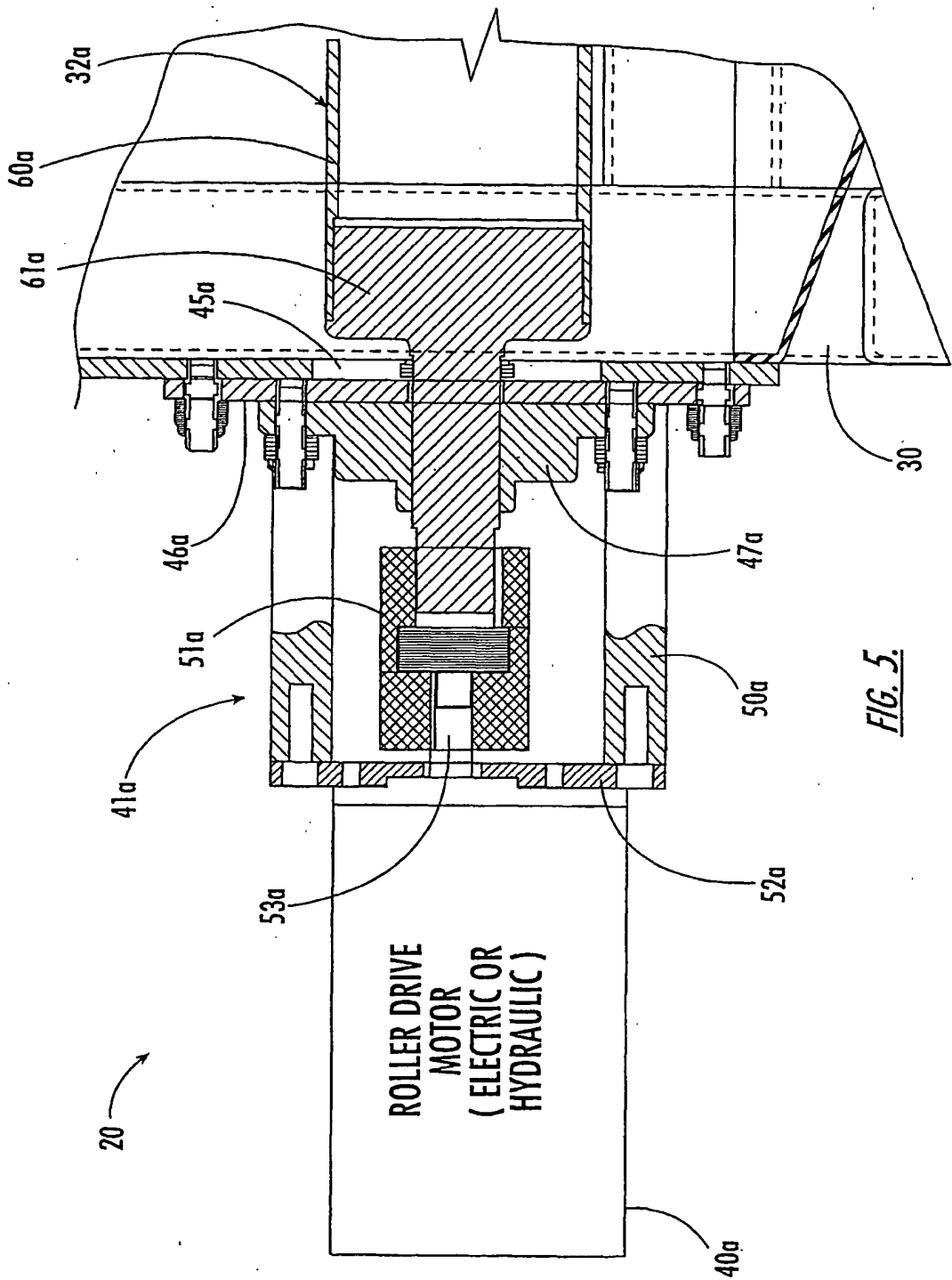


FIG. 5.

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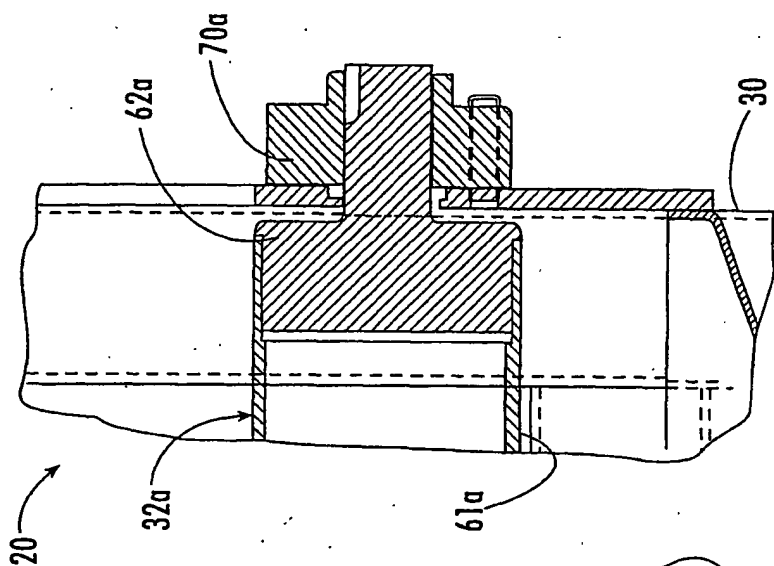


FIG. 7.

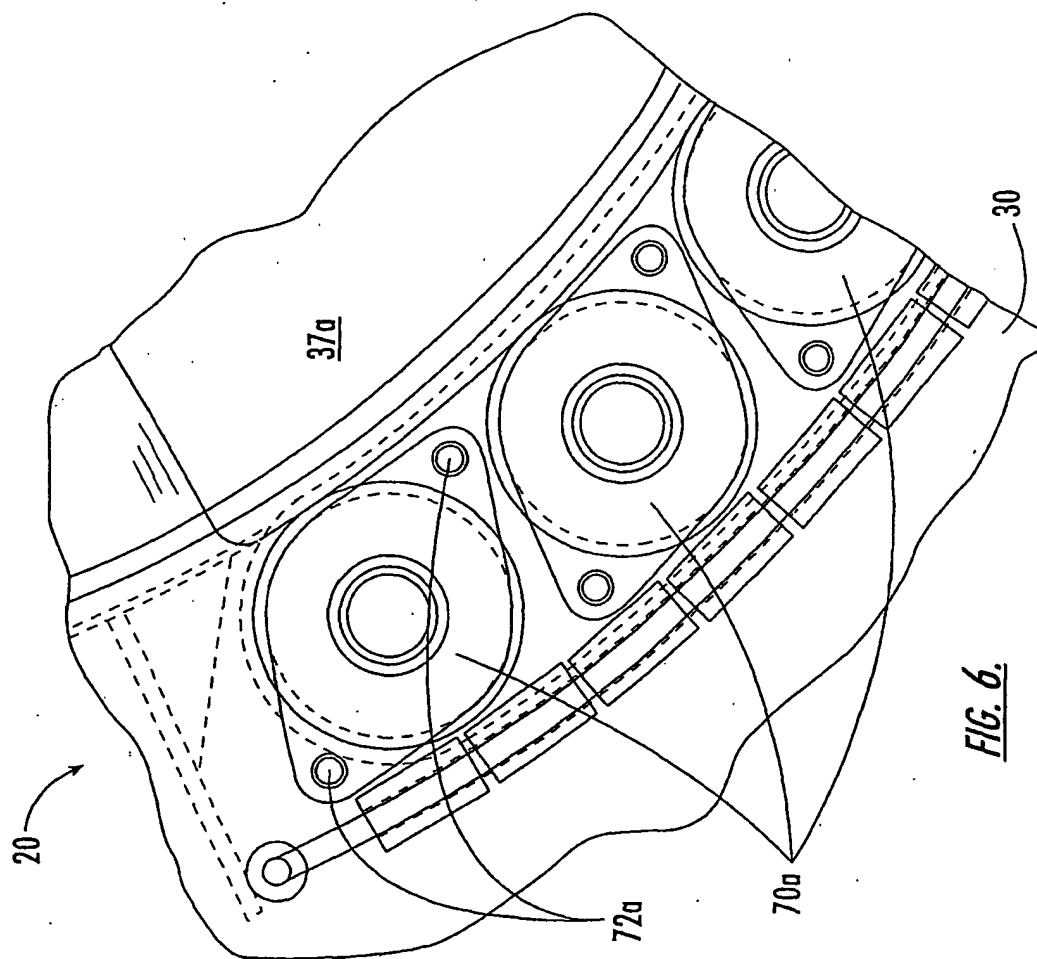


FIG. 6.

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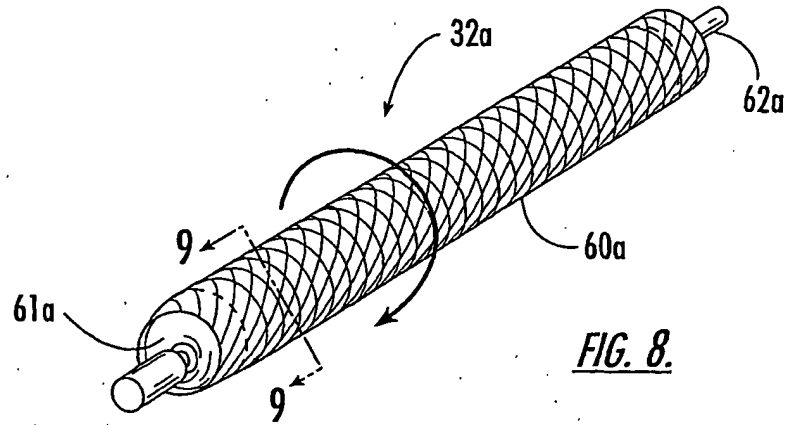


FIG. 8.

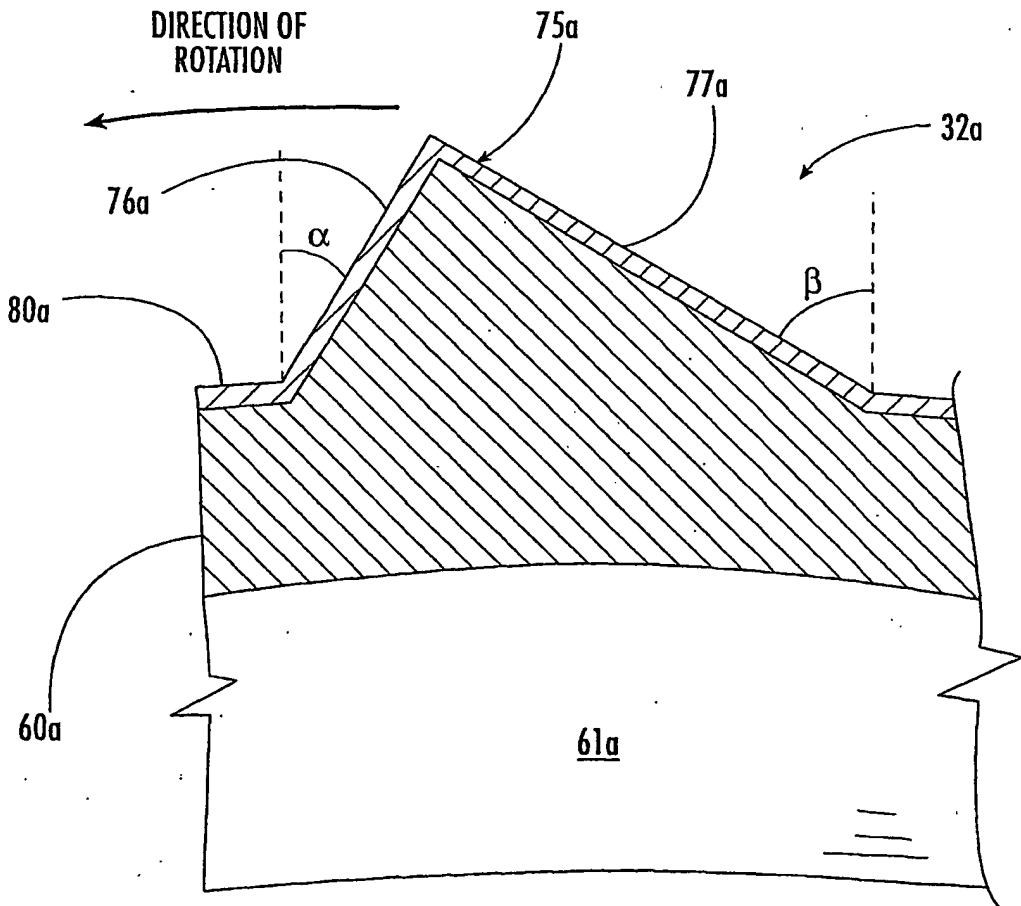


FIG. 9.

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FIG. 10.

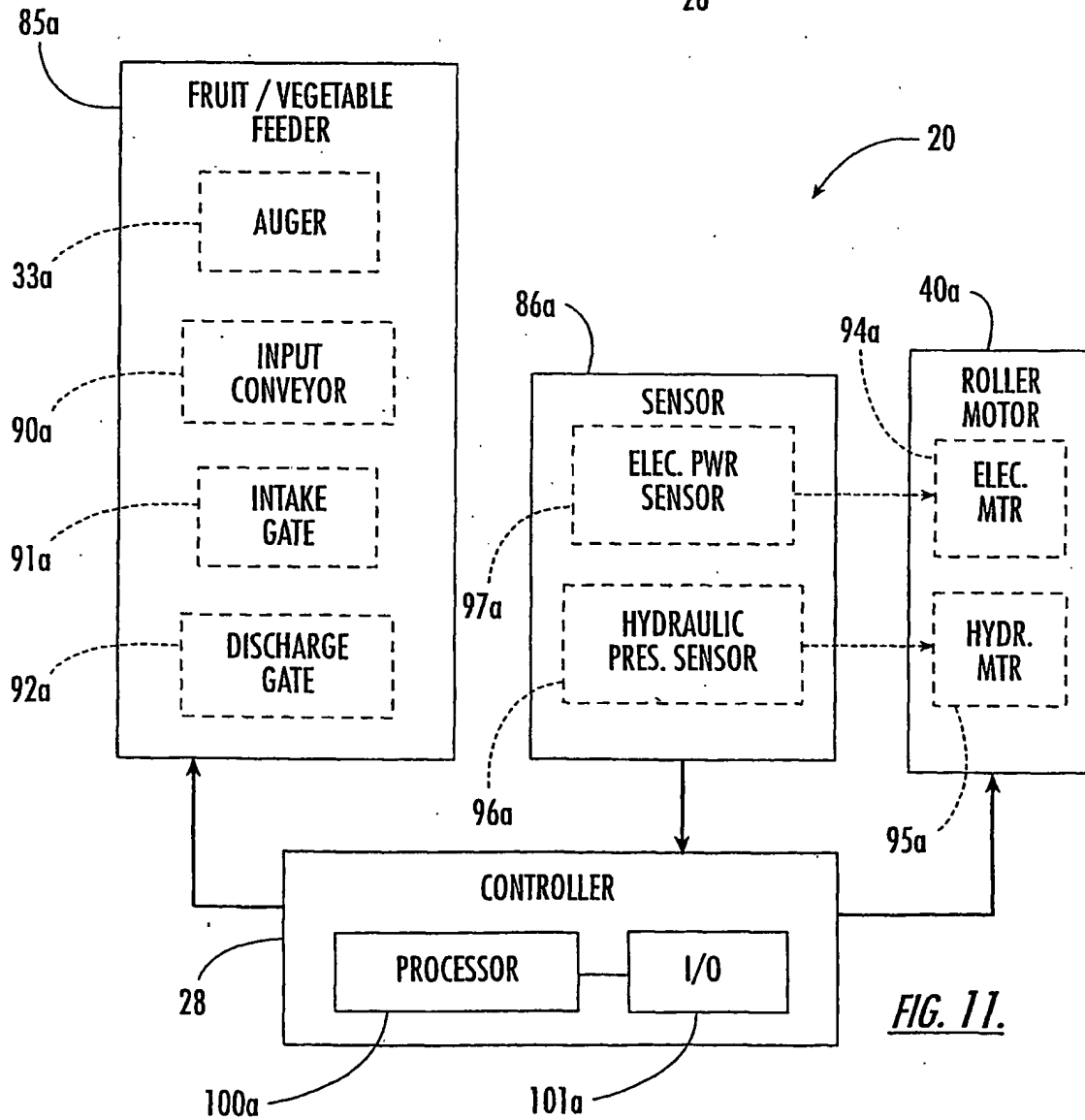
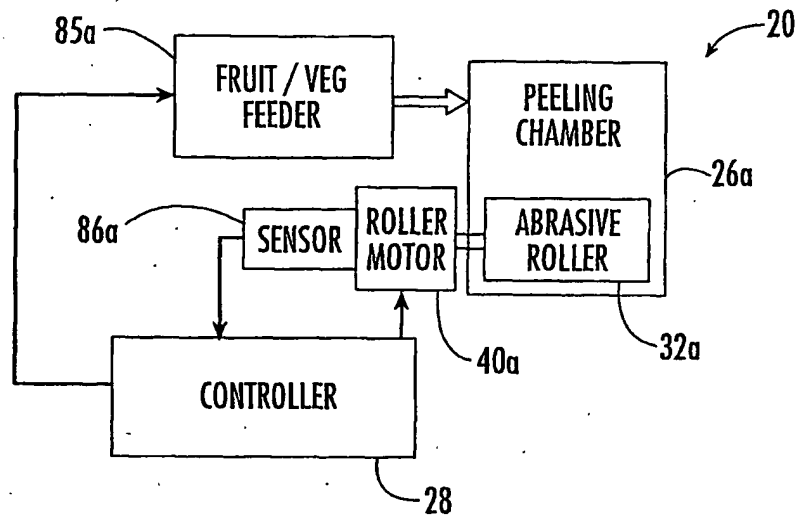


FIG. 11.

INTERNATIONAL SEARCH REPORT

In ☐ onal Application No.

PCT/US 02/08694

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A23N7/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A23N B30B B65G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X, L	US 2001/048960 A1 (SUTER MICHAEL L) 6 December 2001 (2001-12-06) L: Priority the whole document	1-25
A	US 5 780 088 A (ZITTEL DAVID R ET AL) 14 July 1998 (1998-07-14) cited in the application column 3, line 32 - column 4, line 1 column 4, line 57 - column 5, line 3 column 5, line 65 - line 67 figure 3	1, 3, 4, 12, 20
A	EP 1 084 820 A (FREUNT IND CO LTD) 21 March 2001 (2001-03-21) abstract column 6, line 34 - column 7, line 4 figures 2, 4, 9	1, 12, 20

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

19 June 2002

Date of mailing of the international search report

01/07/2002

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INTERNATIONAL SEARCH REPORT

-In onal Application No.

PCT/US 02/08694

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